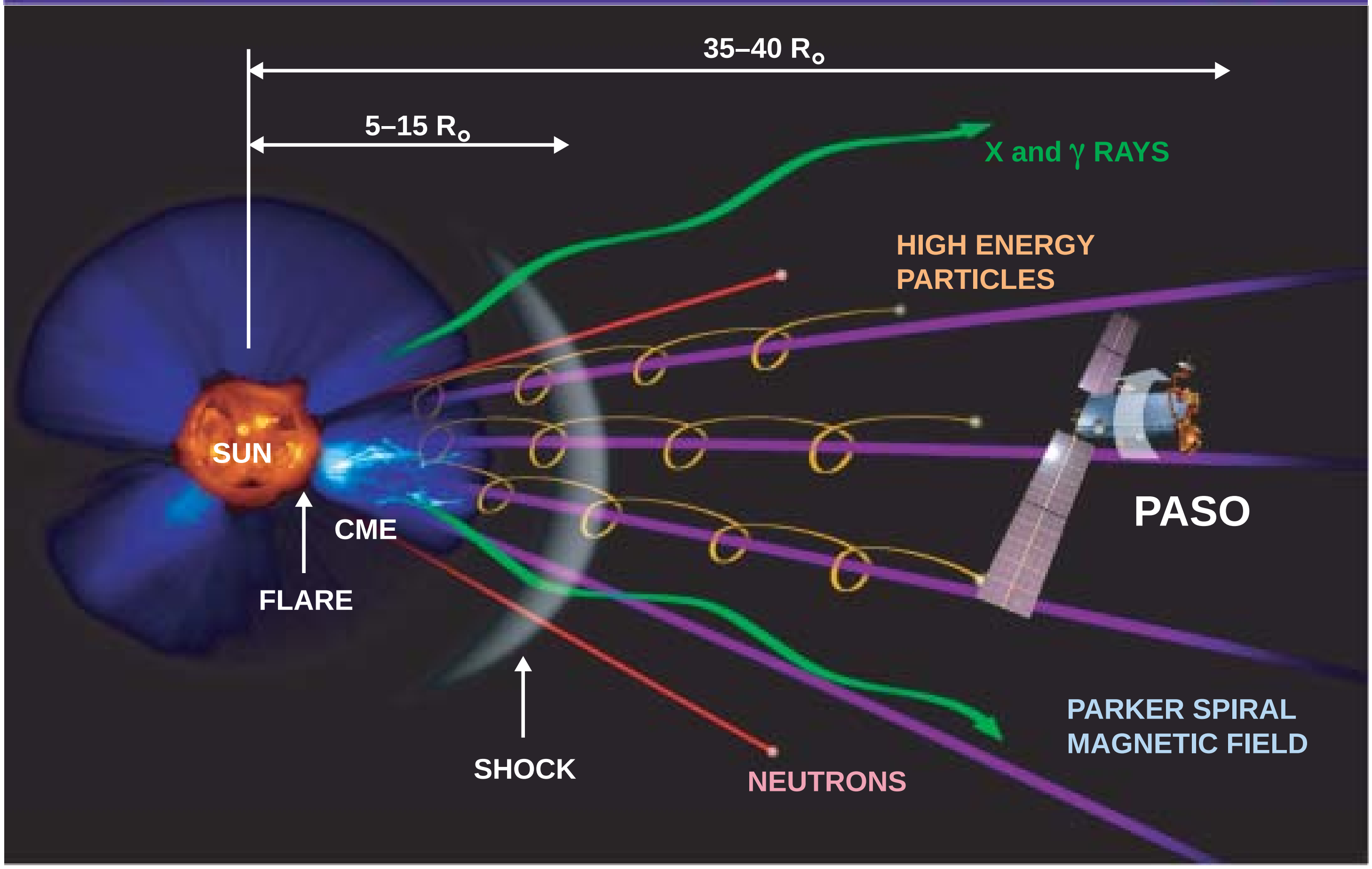
PASO



Particle Acceleration Solar Orbiter (PASO)

Fundamental Question:

- How are particles accelerated and transported in and around the Sun?

Why is this question important?

- Solar energetic particles are a hazard for astronauts and can damage satellite systems
- Predicting the occurrence and intensity of particle events is critical to space program

Science Objectives:

- Measure the spectrum of protons and heavier ions from below 1 MeV/nuc to above 100 MeV/nuc at the Sun and in interplanetary space
- Understand particle acceleration mechanisms in flares, the corona, and in interplanetary space
- Distinguish flare-accelerated particles from shock-accelerated particles in space and obtain accurate coronal elemental abundances
- Study location and nature of energy release and particle transport
- Perform in-situ wave and plasma measurements to reveal conditions for shock acceleration and evidence for post-eruption magnetic reconnection
- Study active-region evolution

Mission Description:

- Delta-class launch vehicle with ion propulsion and planetary fly-bys
- Heliosynchronous orbit from 0.2 AU to 0.3 AU for extended viewing of active longitudes
- Spin-stabilized spacecraft
- In operation before 2010 solar maximum

Measurement Strategy:

- ~1 – 100 MeV/nuc particle telescope that resolves elements up to at least Fe
- Neutron spectrometer sensitive >5 MeV neutrons
- Gamma-ray spectrometer sensitive to nuclear lines
- High-energy solar flare imager (≤1 arc sec)
- Solar wind and magnetic field instruments

Technology Requirement:

- Thermal control system for near-Sun orbit
- Communication and data compression

PASO WILL PROVIDE THE FIRST SYSTEMATIC HIGH-ENERGY EXPLORATION OF THE INNER HELIOSPHERE

• More accurate measurement of coronal abundances

Measurement of composition of solar energetic particles before significant transport effects occur.

• Understanding the acceleration and transport of particles in the inner heliosphere

PASO will fly through the shock acceleration region for high-energy particles and sample three particle populations - trapped, escaping, and locally accelerated.
Comparison of particle spectra and composition at PASO with measurements at 1 AU on STEREO and ACE, and 0.2 AU solar wind and field measurements, provide the first opportunity to separate the roles solar and interplanetary acceleration and transport processes.

• Understanding the relationship between particle acceleration from solar flares and from CME driven shocks

Low-energy neutron measurements along with gamma-ray line measurements provide fundamental information on the transport, spectrum, and composition of accelerated ions in magnetic loops, on MHD disturbances, and on the magnetic fields and density profiles of the solar atmosphere. Direct comparison will be made with accelerated particles in space revealing similarities and differences between the flare and CME-driven shock accelerators.

• Understanding the evolution of the solar wind, CME's, and shocks as they travel from 0.2 AU to 1 AU and beyond

Direct observation of waves and fields thought to be responsible for particle acceleration in interplanetary space.

• Long-duration Observations of Active Regions

The orbital period of a spacecraft at 0.2 AU is close to the mid-latitude rotation period of the Sun. A spacecraft in such a "heliosynchronous" orbit can observe active regions as they corotate with the Sun. When correlated with other observations at 1 AU, this also provides stereoscopic data.

• Solar neutron flux increased by factor of 10^4 (low-energy neutrons detected for the first time)

• Solar photon flux increased by a factor of 25

• Spatial resolution increased by a factor of 5

It is essential that we plan *now* for the more advanced high-energy measurements to be made during the 2010 solar maximum. PASO represents the next logical step in this investigation. This advance will not come through huge leaps in instrumentation technology (the strawman instruments are low-risk, currently available hardware), but through the location of the spacecraft at ~0.2AU. Low-energy neutrons will be observed for the first time (before they decay) and accelerated-particle composition and spectra will be measured before significant interplanetary transport. These measurements, combined with those of flare gamma rays and hard X-rays, the local solar wind and interplanetary magnetic fields, will greatly improve our understanding of particle acceleration in the solar vicinity.